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## REVIEWS OF RECENT LITERATURE.

BREFELD, OSCAR.—*Untersuchungen aus dem Gesamtgebiete der Mykologie. Fortsetzung der Schimmel und Hefenpilze von Oscar Brefeld.* Die Untersuchungen sind ausgeführt im Königl. botanischen Institute in Münster i. W. mit Unterstützung der Herren Dr. G. Istvánffy und Dr. Olav. Johan-Olsen. Quarto. Leipzig, verlag von Arthur Felix. 1888 and 1889. *Heft VII. Basidiomyceten II. Protobasidiomyceten*, pp. 178; 11 lithographic plates. Price 28 marks. *Heft VIII. Basidiomyceten III. Autobasidiomyceten und die Begründung des natürlichen Systemes der Pilze*, pp. 305; 12 lithographic plates.

Space forbids mention of all the interesting and important conclusions reached by Brefeld in these two volumes, which extend and complete Heft III, published in 1877. The work deserves and must everywhere receive the highest praise. A man of less heroic mold would never have undertaken, much less have carried to completion, such a stupendous work. It represents the labor of years, and sums up the critical study of over two hundred distinct species, distributed through about sixty-five genera and subgenera, each of which was grown in sterilized culture media from a single spore. The results of this study, if confirmed by others as in great part they undoubtedly will be, must lead to a number of important changes in classification, one of these being the reduction of the *Uredineæ* to a subordinate position alongside the *Auriculariæ* and *Tremellinæ* under *Protobasidiomycetes*, another being the recognition of the close relationship of the *Ustilaginæ*. *Ptychogaster*-forms are regarded simply as free-living *Ustilaginæ*, and the smuts must consequently be looked upon as reduced or undeveloped *Basidiomycetes*, destitute of pilei, stipes, etc., and restricted to the production of chlamydospores (smut spores). In like manner the *Uredo*-*Teleuto*- and *Æcidio*-spores of the *Uredineæ* are regarded as only so many forms of chlamydospores strictly comparable with those discovered in *Basidiomycetes*.

Nothing need be said here respecting Brefeld's methods, since they have been already generally approved, and are set forth substantially in Heft IV, only such modifications and improvements of methods there described being employed as time and experience showed to be necessary. It is sufficient to state that single spores were cultivated in suitable media and their growth followed uninterruptedly from germination to the production of fresh spores upon simple or compound sporophores. Many of these were under cultivation for months together, and so thoroughly successful were some of his cultures that by the use of larger and larger slides and by the addition of fresh nutrient material he was able to keep some species under observation

for a space of two years, in fact, until, as in case of *Dacryomyces*, they reached unmanageable dimensions. The following are some of Brefeld's conclusions:

The *Basidiomycetes* separate naturally into two divisions, *Protobasidiomycetes* with divided basidia, and *Autobasidiomycetes* with undivided basidia.

The forms of *Protobasidiomycetes* subdivide into three characteristic families. (See below.) The forms of *Autobasidiomycetes* include the *Hymenomycetes* and *Gasteromycetes* of earlier classifications.

The compound sporophore bearing the basidia is of non-sexual origin and nature.

There is no evidence of sexual reproduction in any stage in any member of this group.

The *Basidiomycetes* have been thought to be destitute or nearly so of pleomorphy. The actual case is quite the contrary. They are as much inclined to pleomorphism as any class of fungi, not excepting *Ascomycetes*.

In *Protobasidiomycetes* conidia are of almost universal occurrence. They are borne either on separate conidiophores, on coremia, or on conidial layers. Even pycnidia occur in *Craterocolla cerasi*. In certain cases conidia may also propagate by budding in yeast form *e. g.* species of *Tremella*. In *Autobasidiomycetes* conidia also occur, but are somewhat less frequent.

Aside from conidia there are other associate spore forms, the peculiar Chlamydospores. In simplest form they occur as the well-known "oidia," but they also appear in other and higher forms which occur either singly or in masses like sporophores or like conidiophores. These Chlamydospores have not yet been found in *Protobasidiomycetes*, but in most families of *Autobasidiomycetes* are very widespread in *Oidium* form, less common under more highly developed forms. In some instances entire mycelia assumed the *Oidium* form and propagated repeatedly like "*Oidium lactis*," nor could the author induce them to assume any other form by artificial cultures in nutrient solutions. In the genera *Nyctalis*, *Fistulina*, and *Oligoporus* (*Ptychogaster*) highly developed chlamydospores are particularly abundant.

The discovery of these associate spore forms gives a peculiar character to this whole class of fungi and is extremely important in a morphological sense, not only for the arrangement of the several portions of the class, but also as determining its relations to other classes. Heretofore the basidia and basidiospores were of small value morphologically. They could not be compared with any other spore form. The conidia are the most essential for comparison. The chlamydospores are non-sexual intercalary forms. For the explanation and understanding of the basidia and *Basidiomycetes* they are of no importance.

The basidia are also conidiophores, but with this distinction, they

have become specialized and stand on a higher level morphologically; or, as Brefeld puts it :

*The conidiophore as a basidium* has become typical and regular in form and segmentation and especially in number of spores; *the conidiophore, in the narrower meaning of the word* stands upon a lower level; it has not yet reached this typical regularity of form and in connection therewith the definite number of spores; in both it oscillates continually and, influenced by suitable conditions, is large or small, is thickly covered on its top with spores, or poor in spores, or reduced sometimes even to a single spore.

From this and following statements it is clear that Brefeld considers the compound sporophores of *Hymenomycetous* and *Gastromycetous* fungi as evolutions from earlier and simpler conidial forms, many of which still persist. The impossibility of deriving all these forms from one primitive stock is so apparent that he writes with a grim delight :

Wo bleibt nun hier die Systematik de Barys, etc.  
and again more severely :

Diese Systematik hat höchstens noch den Anspruch, als ein Beispiel fort zu bestehen, welches lehrt, wohin blosse Deductionen in der Systematik führen, wenn sie nicht auf dem Boden der vergleichende Morphologie stehen.

The reader will be interested in comparing Brefeld's scheme of classification here reproduced with that given by De Bary in his *Morphology and Biology*, English ed., p. 132, German ed., p. 142:

*Natural system of the filamentous fungi.*

|   |  |  |   |
|---|--|--|---|
| Phycomycetes (lower, algaë-like, sexual fungi). | I. Class <i>Zygomycetes</i> .<br>Sexual reproduction by Zygosporos.                              | { By sporangia only. (*) }<br>{ By sporangia and conidia. (**) }<br>{ By conidia only. (††) }  | { Mucorini.<br>Thamnidiaë (†).<br>Choanephoreæ (†).<br>Chetocladiaceæ (†).<br>Piptocephalidææ.  |
|   | Non-sexual propagation.  |  |   |
|   | II. Class <i>Oömycetes</i> .<br>Sexual reproduction by cöspores.                                 |  |   |
|   | Non-sexual propagation.  | { By sporangia or conidia. }<br>{ By conidia only. }   | { Peronosporæ.<br>Saprolegnia.<br>Chytridiaceæ.<br>Entomophthorææ.  |
| Mycomycetes (higher, non-sexual fungi).         | Ustilagineæ.<br>Intermediate forms.  | { By sporangia (*) resembling asci. }<br>{ By conidia resembling basidia. (††) }   | { Protomyces (provisionally one genus only.)<br>Ustilago, Tilletia Sorosporium, etc. (the remaining forms of the smut fungi).   |
|   | Propagation.   |  |   |
|   | I. Class <i>Ascomycetes</i> . Propagation by sporangia and conidia. (**) Sporangia in asci.      | Exoasci (asci naked).  | { Exoascus,<br>Taphrina (provisionally only these two genera).<br>Tuberaceæ.<br>Pyrenomyces.  |
|   |  | Carpasci (asci in compound fruit-bodies).  | { Discomycetes (the characteristic mass of Ascomycetes) with their subfamilies.   |
|   | II. Class <i>Basidiomycetes</i> .<br>Propagation by conidia only. (††) Conidia borne on basidia. | Protobasidiomycetes. (Basidia divided).<br>{ Gymnocarpous. (‡) }<br>{ Angiocarpous. (††) }<br>{ Angiocarpous. (††) }<br>{ Angiocarpous. (††) }<br>Autobasidiomycetes. (Basidia undivided).<br>{ Hemiangiocarpous. }<br>{ Gymnocarpous. (‡) } | { Uredineæ.<br>Auriculariæ.<br>Tremellineæ.<br>Pilacreæ.<br>Lycoperdiaceæ.<br>Nidulariææ.<br>Phalloideææ.<br>Hymenogastreææ.<br>Thelephoreæ.<br>Hydneæ.<br>Polyporeææ.<br>Agaricini.<br>Dacryomycetes.<br>Clavariææ.<br>Tomentelleææ. |

The asterisks, etc., denote genetic kinships, indicated in Brefeld's table by connecting lines.

The general observations of Heft VIII are completed by two very interesting chapters on (1) *The Morphological Value of Chlamydo-spores in Fungi* and on (2) *The Morphological Value of Conidia in Fungi*. There is also a sort of appendix on *The importance of light for the development of certain fungous forms*. The conclusion of the latter is that, in the fungi which were examined (*Pilobolus*, *Coprinus*), light has no influence, on sterile mycelial growths, but that it is absolutely essential to the

normal development of the primordia and the compound sporophores, the blue-violet end of the spectrum being the only stimulating portion. In many cases the mycelia remained absolutely sterile when kept in darkness or when exposed only to yellow light.

In his preface to Heft VII the indefatigable author promises to return to the smuts in Heft IX and to the *Ascomycetes* in X and the following Heften. We trust he may be spared life and daylight to the completion of his great task, the material for which he tells us is already in good part accumulated and only remains to be put into proper shape.—ERWIN F. SMITH.

MIYABE, KINGO. *On the life history of Macrosporium parasiticum*, Thüm. *Annals of Botany*, February, 1889.

The investigations, the results of which are set forth in this paper, were carried on at Harvard University under the direction of Dr. Farlow, the material for study, consisting of onion plants, having been sent to him from Bermuda. Without going into the details of the work it may be said that Mr. Miyabe concludes that *Macrosporium parasiticum*, Thüm., is the same as *Macrosporium sarcinula*, Berkeley, and that both of these so-called species are merely forms of the common *Pleospora herbarum*. He further shows that there are only two forms of the *Pleospora*, i. e., the *ascosporous* and the *Macrosporium*, and remarks in his recapitulation that the presence of pycnidia is very doubtful, and may have disappeared from the fungus cycle of development altogether. It is shown that the formation of the perithecia is not attended by any sexual act, and finally that the *Macrosporium*, contrary to the usual belief, is a true parasite, having power of developing within the tissues of plants not previously injured by fungi or other causes.—B. T. GALLOWAY.

LAGERHEIM, G. *Ueber einige neue oder bemerkenswerthe Uredineen*. *Hedwigia* Band XXVIII, Heft 2, p. 103.

In this paper are given the results of some recent observations on several genera of *Uredineæ*, the first of which is *Diorchidium*. This genus, according to the author, was established by Kalchbrenner in 1883 from specimens occurring on *Milletia caffra*, collected at Port Natal, South Africa. It differs from *Puccinia* in having teleutospores divided by perpendicular or oblique instead of horizontal cross-walls. Soon after the attention of mycologists was directed to this peculiar genus, new species were found, the first among these being *Diorchidium lavei*, Sacc. & Bizz., on *Manisurus granulis* from Brazil, and *Diorchidium pallidum*, Winter, on an undetermined host plant from the same place. Later, De Toni in *Sylloge* VII, p. 736, referred *Triphragmidium binatum*, Berkeley, on an undetermined host plant from Nicaragua, and *Puccinia verti-septa*, Tracy & Galloway, on *Salvia ballataeflora*, from New Mexico, to the same genus. In the case of *D. pallidum* and *D. verti-septa* uredo-